

## ИНФОРМАЦИОННЫЕ СИСТЕМЫ И ТЕХНОЛОГИИ

### COMPUTER-AIDED DESIGN SYSTEM SOLIDWORKS: APPLICATION IN MODERN ENGINEERING

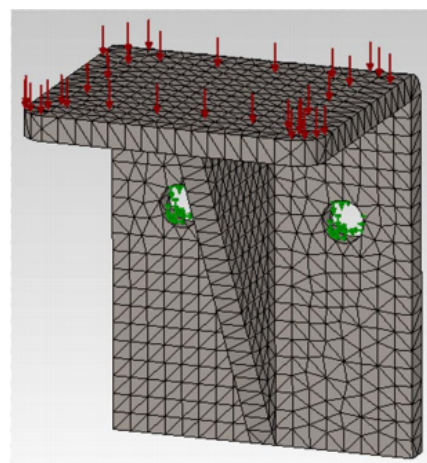
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**Abstract.** SolidWorks is a CAD software package for automation of activities of industrial enterprise on stages of design and technological preparation of production. It ensures the development of products of any complexity and purpose. This system also contains special plug-ins, such as CAE and CAM, which are used to make an engineering stage easier.

**Introduction.** The large part of engineers' and constructors' work is the execution of drawings, layouts and the design of components. In order to facilitate these tasks, nowadays computer technologies are used, specifically – Computer-Aided Design (CAD) – organizational and technical systems consisting of trained personnel and complex hardware, software and other products. One of such systems is SolidWorks, the product of SolidWorks Corporation (an independent division of DassaultSystemes (France)). This CAD system assists in solving various problems, ranging from pre-production design to managing data and processes.

**SolidWorks modules.** Like any high-level CAD SolidWorks includes the following sub-programs: the CAD itself, CAE and CAM. CAD used for the development and design of various facilities, machinery parts and assemblies. In the field of 3D design and construction development this component allows creating a virtual model of a future product. SolidWorks presents a wide range of possibilities for the implementation of this task. SolidWorks is a highly automated system that makes its mastering and use very comfortable process – simple geometric shapes can be created even by the person who works with CAD for the first time. In addition to the 3D modeling SolidWorks also supports 2D drawing for sketches, pictures and drawings. The function of creating drawings for engineered facility is fully automated, it requires minimal adjustments from the user, and all documentation created by the software is compliant with the Russian national GOST standard. Creation of 2D drawings in SolidWorks is also possible from geometric shapes and curves, similar to a vector graphics editor. It is a useful feature and it becomes more comfortable to apply the created pattern to the surface of the object. CAE (Computer-Aided Engineering) plug-in allows application of numerical methods (finite element method, finite difference method, finite volume method) to assess behaviour of the modeled part in real-world operating conditions. CAM (Computer-Aided Manufacturing) is a software calculating complex used for the computerization of the product manufacturing process. Now let's talk about each of these plug-ins in more details.

**CAE plug-in.** SolidWorks Simulation offers the advanced design validation capabilities for every product designers and engineers. It provides simple, accurate design analysis that leads to better products by giving designers a safety net for catching errors. Designers are free to innovate, secure in knowledge that they won't pass costly mistakes down the line [1]. SolidWorks Simulation is a CAE-module based on the method of finite elements and intended for structural analysis. Finite element technique or FEM is a numerical method for solving partial differential equations, derivatives and integral equations arising in problems of applied physics. The essence of the FEM is that the area under study is divided into finite elements, each element is randomly chosen view approx-



*Fig. 1. CAE grid on a detail with an applied load*

imating function, and then there are the values of these functions on boundaries of the elements. The process of dividing the model into pieces is technically a process of creating a grid.

In the Simulation module same geometric model can be supplied with various studies, such as:

- Static studies
- Frequency studies
- BucklingResearch
- Thermal studies
- Impact load research
- FatigueStudies
- Dynamic analysis.

In finite element analysis, the task is represented by a set of algebraic equations that must be solved simultaneously. There are two methods of solving: direct and iterative. Direct methods solve the equations using exact numerical techniques. Iterative methods are intended for solving equations using methods of approximation wherein each iteration is assumed as the approximate solution and the associated uncertainties are calculated. Repetitions should be continued until the error magnitude is acceptable. [2]

**CAM plug-in.** CAM, basically speaking, is an integrated programming environment which is created to facilitate the production of parts, designed in SolidWorks. This module allows creating a program for the processing and manufacturing of essential products and immediately uploading it to the control system of a CNC machine. On the basis of the geometric model created with SolidWorks formative elements of tooling (dies and molds) are produced and numerical simulation processing on CNC equipment is performed. CAM is available in the following configurations:

- 2.5-axis milling
- 3 axis milling
- multi-axis milling (4/5 axes simultaneously)
- 2- and 4-axis turning
- 2- and 4-axis EDM

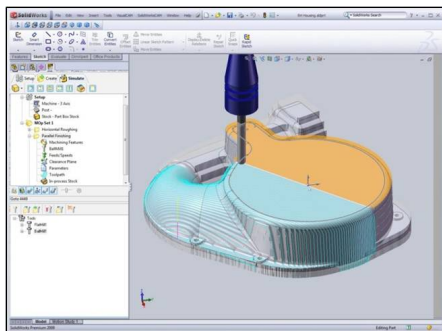


Fig. 3. CAM plug-in during milling

During the development of control programs using CAM systems an important step is post-processing, which is to convert the output of the CAM system into the format used by the control system. Error-free operation of the machine depends from how well-written post-processor is. Therefore CAM has built-in postprocessor libraries for various control rack and also it allows a possibility of custom postprocessor development. [3]

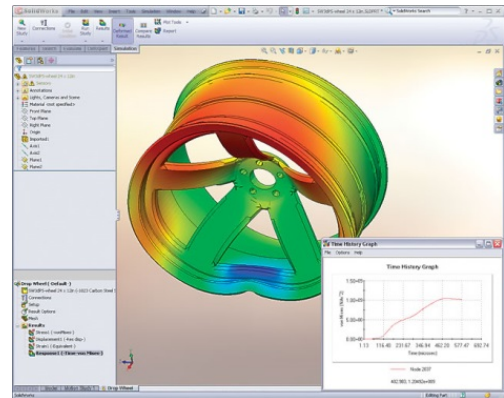


Fig. 2. CAE plug-in interface in process

In CAM plug-in full associativity is implemented within all the changes the geometric model SolidWorks, which provides adaptation of processing operations when the geometric model is changing. Programming is carried out with the use of BASIC-like language, which contains some means of inherent universal programming language, as well as specialized variables and functions. With an intuitive setup file construction, ease of programming language and system documentation time for postprocessor development is reduced to a minimum. Once the postprocessor has been created, it becomes available for use in the user interface of CAM module.

## References

1. CAD Vision Systems [Electronic source] <http://www.cad-vision.com>
2. Engineering analysis in SolidWorksCAD [Electronic source] <http://www.kalexeev.ru>
3. CAM-solutions for production automation [Electronic source] <http://www.sapr.ru/>